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A new species of *Coccomyces* with dimorphic paraphyses

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ABSTRACT — A new *Coccomyces* species found on fallen leaves of *Millettia dielsiana* at Mt Sanqingshan, Jiangxi province, China, is described as *Coccomyces alienus*. This taxon is distinguished from all other *Coccomyces* taxa by having two types of paraphyses. The type specimen is deposited in the Reference Collection of Forest Fungi of Anhui Agricultural University, China (AAUF).

KEY WORDS — foliicolous fungus, taxonomy, *Fabaceae*, fungal diversity

Introduction

Coccomyces De Not. is the second-largest genus in the *Rhytismataceae* (*Rhytismatales*, *Leotiomyces*, *Ascomycota*), of which at least 116 species have been recorded (Kirk et al. 2008, Lin et al. 2012). They are widely distributed and occur on leaves, herbaceous stems, bark, and wood (Sherwood 1980). The study of *Coccomyces* in China began in 1934 with the records of *C. dentatus* on *Quercus* and *Castanea*, and *C. delta* (Kunze) Sacc. on *Lauraceae* (Teng 1934). Subsequently, twenty-eight additional species have been reported (Korf & Zhuang 1985; Lin et al. 1994; Lin 1998; Hou et al. 2006, 2007; Jia et al. 2012; Zheng et al. 2012; Wang et al. 2013; Yang et al. 2013). Of the 159 fungal species known to inhabit *Millettia*, no *Coccomyces* species has yet been reported on this plant genus (Farr & Rossman 2014).

The present study, which is based on a specimen collected from Mount Sanqingshan National Park (Jiangxi Province, China) describes a new species of *Coccomyces* on a *Millettia dielsiana* vine.

Materials & methods

The external shape, size, colour, opening mechanisms of ascomata and conidiomata, and zone lines were observed on dried reference materials using a stereoscope with

10–50× magnification. After rehydration in water for ca 10 min, the fruitbodies were cut into 10–20 µm thick sections with a cryo-microtome. The sections were examined microscopically in water, 5% KOH, Melzer's reagent, or lactophenol-cotton blue. Sections pretreated in water were mounted in lactic acid or cotton blue to observe ascomatal and conidiomatal outlines in vertical section. Colours of various structures and ascospore contents were determined in water. Asci, ascospores and paraphyses were measured and drawn from tissues mounted in 5% KOH. At least thirty asci, ascospores, and paraphyses were measured for each specimen. Figures of the external features and internal structures were drawn using a microscopic painting device. The type specimen is deposited in the Reference Collection of Forest Fungi of Anhui Agricultural University, Hefei, China (AAUF).

Taxonomy

Coccomyces alienus Y.R. Lin & Xiao Y. Wang, sp. nov.

Figs 1–6

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Differs from *Coccomyces dentatus* by triangular to pentagonal ascomata with lip cells and periphysoids, loose-textured and fawn-coloured internal stromatic matrix (textura angularis-globulosa), two types of paraphyses with very different shapes, cylindrical and thinner asci, and narrower ascospores.

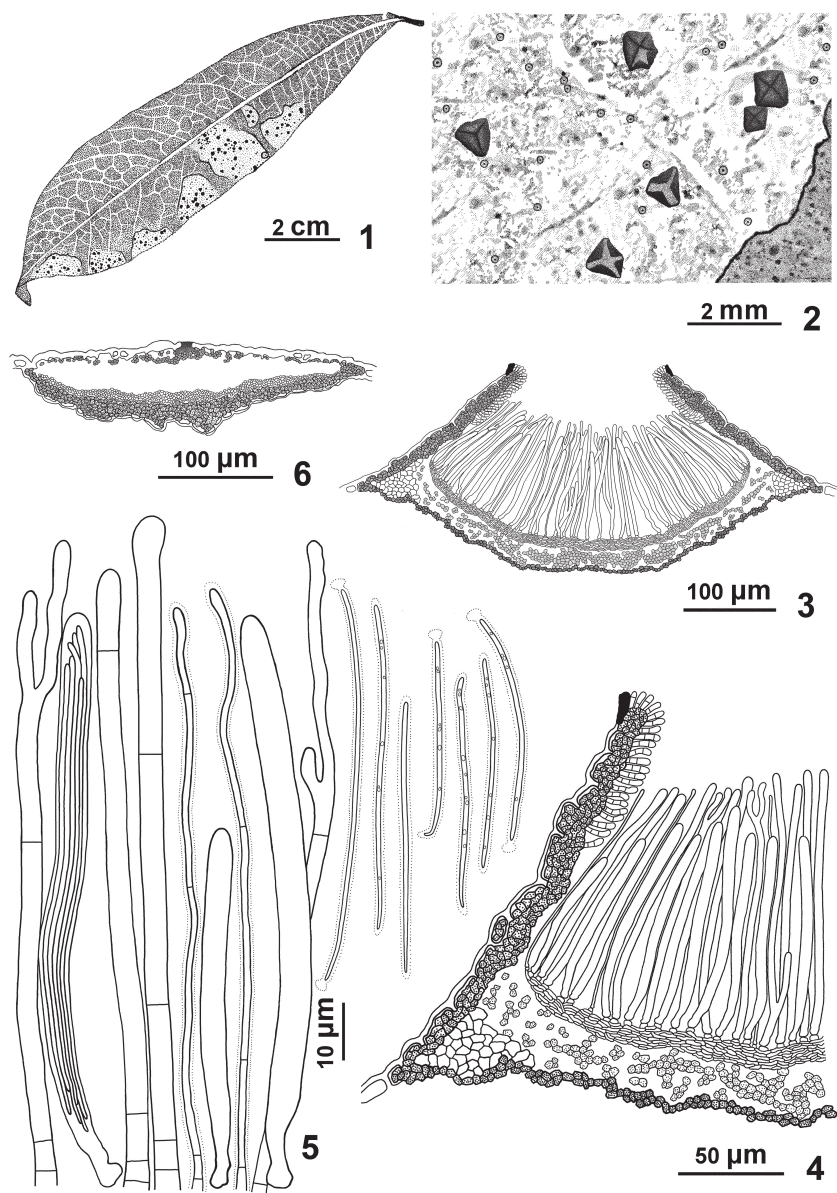
TYPE: China, Jiangxi, Mount Sanqingshan National Park, Bingyudong, alt. 1550 m, on fallen leaves of *Millettia dielsiana* Harms (*Fabaceae*), 21 August 2012, Y.R. Lin, X.Y. Wang & L. Zhang 2661 (Holotype, AAUF 68769).

ETYMOLOGY: *alienus* (Latin = alien), referring to two types of paraphyses with very different shapes.

ZONE LINES generally frequent, dark brown or black, thin, entirely or partly surrounding bleached spots of 8–20 mm diam.

CONIDIOMATA in similar positions to ascomata on the host, scattered to clustered. In surface view, conidiomata 110–260 µm diam., rounded or subrounded, black-brown in the centre and the perimeter line of the conidioma, hazel to brown elsewhere, flattened, discharging spores through an apical ostiole. In median vertical section, conidiomata intraepidermal, more or less lenticular. UPPER WALL extremely poorly developed, yellow-brown but black-brown near the ostiole, composed of tiny angular cells beneath the cuticle. Sometimes individual epidermal cells conjoining the cuticle. BASAL WALL 12–25 µm wide, of dark brown textura angularis with thick-walled cells 3–7 µm diam. SUBCONIDIOGENOUS LAYER 10–15 µm wide, comprised of colourless, thin-walled angular cells 2–3 µm diam. CONIDIOGENOUS CELLS and CONIDIA not present in material available.

ASCOMATA developing on both sides of leaves, mostly hypophyllous, scattered or somewhat clustered, sometimes two or three coalescent; occurring in subcircular or irregular pale areas, sandy-brown in colour with obvious edges. In surface view, ascomata 520–900 µm diam., triangular to pentagonal,



FIGS 1–6. *Coccomyces alienus* (holotype) on *Millettia dielsiana*. 1. Habit on a leaf. 2. Detail of fruitbodies and a zone line. 3. Ascoma in median vertical section. 4. Portion of ascoma in median vertical section. 5. Paraphyses, asci and ascospores. 6. Conidioma in vertical section.

black-brown to black, slightly shiny, moderately raising above the surface of leaf but flat or slightly hollow in the centre portion, edge defined, with an obvious preformed dehiscence mechanism, opening by 3–5 radial splits which extend nearly to the edge of ascoma to expose the cream yellow top of hymenium. Lips poorly developed. In median vertical section, ascomata intraepidermal. COVERING STROMA 15–25 μm thick, composed of blackish brown textura angularis-epidermoidea with thick-walled cells 3–5.5 μm diam., connecting to the basal stroma. There is a small thin mulch that comprises strongly carbonized tissue with no obvious cellular structure on top of the covering stroma, sometimes a few epidermal cells connecting with the cuticle. LIP CELLS hyaline, 5–8 $\times$ 2–2.5 μm , cylindrical, slightly swelling at the apex, thin-walled, 0–1-septate. PERIPHYSOIDS lining the inner face of the covering stroma, 8–15 $\times$ 2–3 μm , cylindrical, often indistinctly swollen at the top, hyaline, straight or curved, 1–3-septate. BASAL STROMA consisting of 1–2(–3) layers of black-brown, angular, thick-walled cells 4–6 μm diam. 25–40 μm thick textura angularis with colorless, thin-walled cells 5–8(–10) μm diam. existing between the covering stroma and basal stroma. INTERNAL MATRIX OF STROMA moderately developed, 20–35 μm thick, comprised of loose, gelatinized, nearly colourless or fawn-coloured textura angularis-globulosa with thin-walled cells 4–8 μm diam. SUBHYMENIUM 10–15 μm thick, slightly concave, consisting of colourless textura porrecta. PARAPHYSES exceeding height of asci by 10–20 μm , of two types: A-paraphyses frequent, 3–4.5 μm wide, thick and strong, cylindrical, straight or occasionally curved, mainly gradually or abruptly swollen to 4.5–6 μm at the apex, sometimes branching near the top or at lower positions, thinly septate, smooth-walled, with no gelatinous matrix; B-paraphyses sparse, 0.8–1.4 μm wide, narrow, filiform, slightly curved, occasionally gradually swollen to 1.5–2.5 μm at the apex, unbranched, septate, covered with a ca. 0.5 μm thick mucous coating. ASCI ripening sequentially, somewhat sparse, 85–120 $\times$ 4.5–6 μm , cylindrical, apex rounded, thin-walled, without a circumapical thickening, short-stalked, J–, 8-spored. ASCOSPORES arranged in a fascicle, 45–75 $\times$ 1–1.2 μm , filiform, slightly tapered towards the base, straight or slightly curved, hyaline, aseptate, containing oil drops, surrounded by a 0.5–1 μm thick gelatinous sheath, sometimes with subglobose gelatinous caps at the apex or both ends.

HOST SPECIES, HABITAT, & DISTRIBUTION: Producing conidiomata and ascomata on fallen leaves of *Millettia dielsiana*. Known only from the type locality, Jiangxi Province, China.

COMMENTS—*Coccomyces alienus* is very similar to *C. dentatus* (J.C. Schmidt) Sacc. in the way ascomata and conidiomata are embedded, the opening form of fruitbodies, and the lack of excipulum. However, *C. dentatus* has quadrangular to hexagonal ascomata with nonexistent lip cells, periphysoids, and a black

mulch that occurs on top of the stromal covering, a virtually absent internal stromal matrix, monomorphic, shorter (80–105 µm long) paraphyses, shorter and thicker (70–105 × 8–10 µm) cylindric-clavate asci, and thicker (2 µm wide) ascospores (Sherwood 1980).

Coccomyces limitatus (Berk. & M.A. Curtis) Sacc., which produces macroscopically similar zone lines, ascomata, and conidiomata and similarly shaped periphysoids, asci, and ascospores, differs from *C. alienus* in its absence of lips, a well developed excipulum, a covering stroma not extending as far as the basal stroma, a subhymenium of globose cells, and a much thicker (up to 50 µm thick) internal stromal matrix composed of loose hyphae and crystals (Johnston 1986). Sherwood's earlier (1980) observation that the excipulum and periphysoids of *C. limitatus* are absent was contradicted by Johnston (1986), who suggested that the excipulum of *C. limitatus* form after the ascomata open and may not be obvious when immature. Young ascomata have the appearance of a well-developed layer of short, hyaline, cylindric paraphyses that lengthen and develop septa to form the excipulum.

Coccomyces cyclobalanopsidis Y.R. Lin & Z.Z. Li, which resembles *C. alienus* in the zone lines, the way the ascomata open, and the shapes and sizes of the asci and ascospores, is distinguished from the new species by its triangular to hexagonal ascomata, covering stroma and basal stroma consisting of textura globulosa, the longer and thicker (12–20 × 3–4 µm) periphysoids, absent lip cells, excipulum arising from the inner layer of the covering stroma, and the extremely poorly developed internal stromal matrix of textura intricata (Lin et al. 2000).

We observed that *C. alienus*, which produced mature or overripe conidiomata and ascomata on recently dead leaves, was often confused with *Terriera minor* (Tehon) P.R. Johnst., whose immature or barely mature ascomata could be easily distinguished on a same leaf, suggesting that *C. alienus* fruits earlier than *T. minor*. This new fungus may be a weak pathogen causing leaf spot. It is possible that it first develops latently within the living leaves but exhibits no obvious symptoms, after which the asexual and sexual stages appear sequentially on the brown lesions of the infected leaves as the bioenergy of the host declines. Thereafter diseased leaves become reddish brown or sandy-brown and fall during July and August. Sherwood's (1980) observation that most *Coccomyces* species fruit on recently dead plant materials is largely consistent with our observations.

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